Growth Mindset Training for and in the Labor Market

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Abstract

Rapid technological advances in robotics and artificial intelligence influence the challenges and composition of tasks completed by workers, in both existing and emerging occupations, necessitating nearly continuous learning and experimentation among managers, workers, and new/returning labor market entrants. In this project, funded by a subgrant of the Federal Build Back Better Regional Challenge award focused on workforce development training programs in Southwestern PA, we embed growth mindset training in existing workforce development programs. The growth mindset training is interdisciplinary (using neuroscience, education, and cognitive psychology research), and is collaboratively designed with the community stakeholders, using a community-based/community-engaged research approach. We implement the training with organizations that support key populations including youth, justice-involved job seekers, skilled apprentices and trainees, and educators at all levels (K-12, regional universities, and community colleges). This paper discusses the training components, which affirm to both job trainers and trainees that our skills are malleable and improve with effort, support, and strategies. In this phase of the project, we train job trainers/instructors/mentors of training programs and use a pre-post assessment to determine the effectiveness of the training session. Results imply that a short 75-minute session can influence trainers’ mindset beliefs (by .88 s.d.) and self-efficacy by 14 percentage points (or .84 s.d.). This paper provides resources for others to implement growth mindsets in their contexts and discusses directions for future work.

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1 Introduction

Rapid technological advances in robotics and artificial intelligence influence the challenges and composition of tasks completed by workers, in both existing and emerging occupations (Brookings, 2022). While these technologies enable increased productivity, they also necessitate continuous experimentation, learning, and growth among managers, workers, and new/returning labor market entrants (with re-skilling needs among an estimated 1 billion workers globally, World Economic Forum, 2024). Historical research has warned that technological change risks exacerbating inequalities and inequities in accessing high quality jobs (Acemogulu, 2002), unless previously under-served or historically excluded workers are intentionally included in upskilling programs (Cukier, 2019). Yet, even after making inclusive upskilling more accessible, programs face significant skill gaps among participants and retention challenges (McKinsey, 2017). The management style, culture, and training environment are shown to significantly predict program participation outcomes, with a significant opportunity for embedding a growth mindset in human resource development (Murphy, 2024; Han and Stieha’s 2020 review).

Embedding a growth mindset culture into existing workforce development programs affirms to training program participants that anyone can grow and develop their skills with effort, support, and strategies (Dweck, 1999, 2006). This differs from programs that seek trainees and workers who already have the pre-requisite skills, potentially viewing their abilities and characteristics as innate or permanent features (a key fixed mindset belief). Growth mindset-oriented training acknowledges and anticipates transformational development and growth of participants, and posits that growth-oriented beliefs may enable higher persistence, increased performance, and greater inclusion. While there is much debate in
psychology and education research regarding the role and efficacy of mindsets, conditions
that are postulated to produce the highest impact of a growth mindset are when there is a
consequential challenge and opportunity for change (Yeager and Dweck 2020). Job training
programs, particularly programs that utilize emerging technologies (advanced manufactur-
ing, industrial robotics, software development and digital technologies), present both an
opportunity and consequential challenge for incumbent and re-skilling workers. Therefore,
the hypothesized potential for embedding a growth mindset in these programs is high.

In this project, we collaboratively design, train, and support existing job training pro-
grams in our region leverage growth mindset training/teaching cultures. Our work is a
train-the-trainer intervention. Uniquely, we deliver training and engage with these pro-
grams/community partners amid a period of significant technological change in robotics
and artificial intelligence. Our intervention design and research methodology is community-
based and participatory (Collins et al., 2018). Our community engagement included groups
working to support youth, justice-involved job seekers, skilled apprentices and trainees, edu-
cators at all levels, and higher education faculty, mentors, and students. Our intervention is
co-designed, but significantly structured and generally standardized to allow for comparison
across contexts. We incorporate partner-specific examples and strategies in our training
session and data collection to increase relevance and engagement of the research within the
community. For our data collection, we leverage customized, but comparable, surveys to
measure growth mindset orientation, self-efficacy/confidence, and their changes from base-
line to post-training.

Consistent with our hypotheses and the literature, we find promising short term indica-
tors that the growth mindset training helped orient job trainers towards a growth mindset,
increased their confidence in their ability to create a growth mindset culture, and offered
them valuable and tangible strategies to do so. Early findings reveal that even among job
trainers who are more likely to endorse growth mindset beliefs pre-training, there is statisti-
cally significant gains in mindset orientation (an effect size of 0.88 $s.d.$) post-training. While
popular press has acknowledged the potential of a growth mindset, prior to our intervention,
we find participants have lower self-confidence/efficacy assessments for **how to implement a growth mindset culture**, with large improvements (by nearly 14 percentage points or \( .84 \text{ s.d.} \)) post-training.

Our study builds on the large and growing literature in psychology, social psychology, education, and human resource development that studies mindsets. In Section 2, we examine that literature and highlight the findings that informed our training design. We make a distinctive contribution by examining multiple contexts, empowering community partners, and measuring immediate effects: we specifically describe our research and implementation design in Section 3. Our emerging results are presented in 4 and we provide actionable recommendations alongside our research conclusions in Section 5.

### 2 Contribution to the Existing Literature

In this section, we provide a brief review of growth mindset research and emphasize applications to education, workforce development, entrepreneurship, and business. We synthesize across economics, education, organizational behavior, and psychology disciplines. These papers, and their key findings, informed the growth mindset training we developed with community partners, our survey design, and the hypotheses we test in our data collection.

Growth mindset beliefs that affirm that with effort, support, and strategies it is possible for everyone to improve and experience growth, whereas fixed mindset beliefs endorse the belief that a workers characteristics, skills, and productivity are fixed or largely unchangeable. Believing your skills and characteristics are fixed may be a limiting belief, particularly when a worker initially lacks a new or emerging skill set (as is the case in many emergent technology settings). Research suggests learning in a growth mindset culture or following a growth mindset intervention is associated with increased effort, persistence through challenge/expected difficulty, higher retention, and increases in confidence, performance, and learning (Dweck, 2009, Panesku et al., 2015; Yeager et al., 2019; Yeager and Dweck, 2020).

The scientific underpinning of growth mindset beliefs are concepts from neuroscience,
including studies of working memory and neuroplasticity. Brain imaging associates growth mindset beliefs with improved working memory (Zhao et al., 2022). Neuroplasticity refers to the way our neurons make new electrochemical connections in our brain when we learn, and research shows those connections are strengthened into more automatic habits with repeated practice (Altman, 1962, Willis, 2010). Recent research has confirmed that cognitive skills can be built and strengthened in all learners, regardless of age or starting point; these skills are developed through repeated practice, sustained effort, helpful strategies, and a supportive community (Anderson, Boaler, and Dieckmann, 2018). These facets are critical for us to affirm in our training, as inclusive training programs should address existing structural inequities in access to education and exposure to the emerging technologies.

The plasticity of the brain is also relevant to its potential to generate intrinsically motivated behaviors (Ng, 2017). Trainers/managers can support intrinsic motives for learning and development in growth mindset cultures, nurturing individuals to learn as they understand that intelligence is malleable.

Within the workplace, the role of culture, leadership styles, and management practices may also embody a growth mindset (Murphy, 2024). A growth or “learning” mindset can be implemented within a leadership structure and align incentives for professional development investments. For instance, leaders who exist within a “learning” mindset culture have been found to grow quicker into their careers, report higher satisfaction rates, and build upon past mistakes. (Heslin and Keating, 2017). Growth mindsets are not just a tool for the mentee in a professional relationship, but the mentor as well.

Being able to grow within your role as a leader is heavily tied to the productivity of your team, and can be heavily dependent on the level of growth mindset culture within your organization. As a result, it is not enough to hold growth mindset interventions with entry-level or direct report employees, but an organization must also hold the same training for its management if it wants to foster a growth mindset culture (Lyons and Bandura, 2018). For this reason, we proposed training for both trainee/workers and trainers/managers in our grant application.
Growth mindsets also affect how a leader interacts with their direct reports. By using different learning approaches, persisting toward task achievement, and assessing progress achieved, leaders can create a “growth culture” where their subordinates are able to learn from their mistakes (Lyons and Bandura, 2018). Growth mindset cultures share similarities with characteristics of servant leadership. A servant leader is essentially a lifelong learner with a growth mindset, continuously developing various aspects of servant leadership. Servant leaders are those who focus on the mentorship aspect of management: they frequently meet with their direct reports on their personal growth, “debug” with their teams in spaces where mistakes can be shared and learned from, and treat the skill growth of their direct reports with the same priority as their primary deliverables. This process requires long-term commitment and perseverance, and a growth mindset plays a crucial role in acquiring these behaviors (Chan, 2016). Finally, growth mindsets share similarities with grit (Duckworth et al., 2007). Grit/growth mindset is seen as the primary moderating variable in servant leadership and job performance, meaning the creation of a growth culture benefits the leader as much as their direct reports (Ullah et al., 2023).

There are many variables that correlate with workplace culture and growth mindset in the workplace. For instance, collaboration, worker engagement, and self-efficacy mediate growth mindset in the workplace (Lyons and Bandura, 2023). Collaboration is measured by the amount of work in a typical role would be divided into individual or collaborative. While not a direct relationship, a minimum amount of collaboration is needed for growth mindsets to take hold in an organization. An aggregated statistic, worker engagement may be measured by a combination of meeting attendance, email response rates, and professional program participation. If there is no level of engagement between employees, research highlights that self-efficacy and growth mindset training will have little to no effect on worker productivity (Nandini et al., 2022). Because worker engagement acts as a mediating

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1Worker engagement is still a working concept in the labor research field, but existing studies suggest metrics that can classify worker engagement in an ordinal way. For instance, by measuring employee participation in non mandatory meetings, average response times for email requests, and the prevalence of Employee Research Groups (ERGs).
variable, firms require a sufficient minimum amount of worker engagement to incubate any level of growth mindset into your organizational culture. However, worker engagement is also affected by growth mindset management. Managers can create opportunities for self-efficacy and evaluation of worker mindsets and use that data to understand where training can provide benefit. This finding informs our pre-training measurement of mindset and self-efficacy discussed in further detail below.

One tangible example of firms independently implementing growth mindset training was in after action training/reviews as discussed in Lyons and Bandura (2023), where managers and reports review their last major project or deliverable in an open, iterative space. After Action Reviews (AARs) are a professional discussion of an event, focused on performance and lessons learnt. However, examples of this in the civilian workplace are often reduced to 6 month review sessions, with an emphasis on the high-level assessment of an employee rather than specific assessments of duties or deliverables. Workplaces adapting a more formalized AAR policy will allow for a larger amount of these open discussions, fostering a growth mindset culture.

In our survey, we measure self-efficacy of both trainers and trainees. Self-efficacy, or an individual’s belief in their ability to complete a task, is heavily correlated with the ability for growth mindsets to work in practical settings (i.e., both high self-confidence and growth mindset enable increases in output). This is in part due to Self-Efficacy minimizing the negative effect occupational stress can have on growth mindset adoption. Without this, high stress environments can blunt or even fully nullify growth mindset effects on improving counterproductive behaviors (Li et al., 2021).

Together, a high-level of self-efficacy and growth mindset adoption allows for an increase in “proactive” tasks in the workplace. Proactive tasks are defined as any task completed by an employee that is not either delineated in their daily work duties or directly given by a manager (Morris et al., 2023). Self-efficacy correlates with reception to growth mindset and

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2AARs have been a long standing tradition in several industries, with the American Military being the most long standing user of this tool/standard. They enable soldiers to discover for themselves what happened, why it happened, and how to sustain strengths and improve on weaknesses.
multiplies the effects of growth mindset training (hence the increase in “proactive tasks” in the workplace setting). Proactive tasks are often done without direct supervision, allowing direct reports to have more ownership over their time in the workplace. This kind of task can encompass everything from a standardization document to creating a new data tool, as long as the task was not directed from management beforehand. These tasks are associated with higher levels of employee engagement and retention, leading to the same outcomes growth mindset interventions hope to reach.

In our training, we account for these mediating and moderating variables during the re-framing and applied practice sections. These sections allow for participants to self identify their perceived blockers for growth mindsets while collaborating with peers for hypothetical solutions. Participant responses and feedback inform how collaboration can affect self-efficacy and their individual belief in a growth mindset.

3 Study Approach

Implemented in 2023-2024 and funded by a subaward of the Build Back regional challenge grant won by the Southwestern PA New Economy Collaborative, our project sought to engage with and support existing training programs, while assessing our efforts. Uniquely the upskilling pillar of the larger grant’s focus was to advance equitable growth, in an inclusive, empowering, technology forward, and regional approach. The larger Southwestern PA BBB project coincided with increases in public awareness, use, and development of artificial intelligence and advances in robotics. Our one-year project subaward sought to replicate previous research and growth mindset interventions done with university students in existing community-based training programs. During the training development, we reviewed learning science, labor economics, human resource, and human capital development research on growth mindsets- specifically identifying what parts and how growth mindset training might best reach non-traditional (and traditional) trainees in community groups, vocational, technical, and industry training centers. Concurrently, we approached and welcomed community
partners to collaborate. In this section, we explain our community-based philosophy, provide an overview of the training content, describe the settings the training was implemented in, and the data collected.

3.1 Community-based participatory research design

Our intervention design and research methodology is community-based and participatory (Collins et al., 2018). Community-engaged or community-based participatory research (CBPR) seeks to include the community stakeholders throughout the entire design, implementation, and assessment of a research project. Research on the philosophy of CBPR argues that this approach better connects researchers to the community being studied, is symbiotic (benefiting community participants, researchers, and the community organizations), and has a potential to address inequities (Viswanathan et al., 2004). In this section, we describe how we engaged partners, co-designed the training, adapted the data collection, and supported the partners in their continued use of what we co-created. We worked with many community groups who support youth, justice-involved job seekers, skilled apprentices and trainees, educators/faculty at all levels, mentors, and students.

Community partners that we worked with were either connected to us through the BBB Southwestern PA New Economy Collaborative or reached out to us after reading/hearing about our project in local news coverage. When we were introduced to a potential partner over email, we provided a one paragraph summary of our project idea, and asked if they were interested in collaborating, and if so, arranged an introductory meeting. Most of the introductory meetings occurred over Zoom, ranging from 25-50 minutes in length, however in a few instances, partners invited us to their locations. When partners reached out to us or were referred to us by an existing partner, we similarly began with this introductory meeting. The meeting provided us a chance to learn about the partner’s work, introduce ourselves and the project’s research questions, outline our community-engaged philosophy,

3Many news sources covered the larger BBB regional award, highlighting specific projects, and we were grateful NextPittsburgh profiled our project in December 2023.
describe the project components, and expectations should we collaborate. For Zoom based meetings, we used a relatively standardized set of pitch slides that covered this content, Figure 1 reviews our stated expectations. For ease of explanation, next we describe the project timeline for one partner: Bidwell Training Center. Importantly, with each partner, as described here for Bidwell, we sought to create value for them, personalize to their context, and be on hand to support retention of the training topics and use of the training skills in their training programs.

**Expected Commitments**

From PI: Ashley Orr and team
- A first and final draft of the survey and data collection instrument (implemented in Qualtrics)
- A first and final draft of the trainer growth mindset training
- Submission of the training and survey to the human subjects research review board.
- Provision of the training
- Data collection and analysis
- A final presentation of the results to your team, with time reserved to discuss and support your future use of growth mindsets
- Open and active communication

From [Insert Partner Name Here]
- A working meeting to finalize survey questions and data collection
- A working meeting to align training to your culture, norms, and setting
- Hosting the training (i.e. advertise and invite your team)
- Send out the survey to trainees, with a reminder
- A final meeting to summarize findings and discuss if you plan to enact any growth mindset updates to your curricula
- Open and active communication

![Figure 1](image.png)

Figure 1: When pitching our collaboration to potential partners, we clearly outlined the proposed project and expected commitments.

### 3.1.1 Example of Partner Collaboration and timeline: Bidwell Training Center

The Bidwell Training Center, a vocational training center that has operated on Pittsburgh’s North Shore for over 50 years, reached out to the PI-Orr by email in early January 2024, and the project PI and two graduate research assistants met some of their leadership and

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4This partner consented to being highlighted and their leadership reviewed and consented to the text of this draft.
toured their facilities on January 11, 2024. Over a lunch meeting, we learned more about their mission, specific goals, and challenges. We provided an overview of existing research on growth mindsets in educational settings and described the proposed components of our training session for trainers (or in Bidwell’s case, their faculty). We asked about their interest to collaborate and clearly stated we welcome and encourage one or more of their team to work closely with us on the training design, assessment question wording, and the final grant reporting. We explained our research questions and explained that our in-progress, at the time, IRB application requires a local site letter granting approval to conduct research and collect non-identifying data on their premises. We emphasized that the BBB grant enabled us to provide the training and conduct the research at no cost to partners, that they are welcome to adapt and use in the future materials we co-create, and to use their partner specific data analysis findings, however they best see fit. Once a partner decided to participate, we immediately sought to schedule the training date, and in an ideal case, would schedule it 8 weeks after our initial meeting to allow enough time to customize the training and survey. For Bidwell, we scheduled the training in person on April 5, 2024. Table 1 exhibits the full timeline described in this section.

With Bidwell, and all partners, working with them provided us the opportunity to learn about current practices in training and workforce development. What we learned and what they asked directly shaped our training, as we sought to personalized our training content

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5If a partner decided to proceed, we asked for them to provide that letter so we could upload it to our research protocol.
to their setting, culture, and norms. During our second and third meetings with their team (in February and March), we co-wrote or directly incorporated Bidwell’s programs and trainee course milestones, and challenges, into all of the examples we would use during the training session. This allowed us to personalize the training activities to Bidwell (and all partners). We found providing partner specific examples increased the relevance of the training to the trainers and may increase engagement during the session, as participants saw their organization centered or focused on in the training. These meetings also allowed our partners to see the training draft in full, prior to our presentation, facilitating their peer review. Their questions and feedback was encouraged and prompted us to revise the training slides. For instance, feedback from Bidwell helped us improve our communication of the existing research, favoring slides with more relevant examples and fewer blocks of text.

Also during the second and/or third meeting with the partners, we reviewed a draft of the non-identifying survey instrument. This draft was a template that we had submitted with our IRB protocol, that specifically left blanks or spots to fill in with our partners’ training learning objectives, and allowed us to customize the examples to our partners’ challenges according to high-level themes. We also provided a copy of the consent form that explained the purpose of the project (to assess and improve the training) and use of the data (only to be presented in aggregate). We explained how in Qualtrics we adjusted the metadata to prohibit the collection of IP addresses, making our survey truly non-identifiable, and shared our screen and exhibited how participants of the survey would be taken to the end of the survey if they were less than 18 years of age and did not consent to participate.

We then provided the training, in Bidwell’s case, on April 5, 2024 at noon. The training was on-site, in a classroom, and had 19 attendees from 21 total invited faculty and leadership. The training, described generally below, was similarly 75 minutes long, and we observed that all attendees participated and were engaged. The training survey was shared via a QR code and data collected was coded and analyzed by the PI, with results replicated by a research assistant, approximately one to two weeks after the training. In some cases,
including Bidwell’s we offered to hold post-training Zoom office hours where we engaged in unstructured discussion and question and answers about the training contents with those who attended the training. At Bidwell’s office hours on April 10, 2024, five attendees joined and shared about ways they plan to implement growth mindsets in their training courses. When office hours were used, data analysis occurred after the office hours. The aggregated results were then summarized in a partner-specific slide deck, which was presented in a final partner meeting, in Bidwell’s case on April 26, 2024. During that meeting, we review and interpret the findings and facilitate a consultative style of post-training reflections by asking, “How did you feel it went?” and then we shared our slides and findings from the survey. These slides presented results parallel to the fully aggregated findings we described in this paper, however, were partner specific, and shared with the partner by email, immediately after the meeting along with a note of appreciation.

3.2 Overview of Contexts Implemented

At the time of writing, we have directly engaged with 10 existing training programs in the Southwestern PA region. We also pitched a training to several other organizations who were unable to participate\(^6\). For the training partners we had, they included: small community-based/volunteer driven nonprofits, a mid-sized technical training center, a large, public university branch campus, a large private research university, a volunteer-based council/advisory group, and private for-profit and nonprofit training companies. These groups serve students, both young adults and youth, trainees of all ages\(^7\) re-entering workers, veterans, and more. All groups’ training were either directly or indirectly associated with advanced technologies (use of robotics, advanced manufacturing/automation, or AI). Across all 10 partners, we directly engaged with or trained 165 trainers, managers, or training leadership; however, we either were not able or did not always observe complete responses, so

\(^6\)Reasons for non-participation varied, some examples include: the company was acquired and management reshuffling created uncertainty, legal concerns with data sharing, and unavailability of/scheduling difficulties among collaborators.

\(^7\)We only interact with participants aged 18 years or older.
3.3 Review of the Growth Mindset Training Session

Informed by existing growth mindset training programs (Yeager et al., 2019), we designed our training session template to be participatory (using active learning and structured discussions). We set the following learning objectives, so that at the end of the training, trainers would be able to confidently:

1. Describe how neuroscience confirms skills can be built at all ages/by all,
2. Identify the difference between a growth and fixed mindset,
3. List the costs of a fixed mindset & benefits of a growth mindset,
4. Practice re-orienting ourselves (and trainees) towards growth mindsets,
5. Describe components of a growth mindset learning culture,
6. Discuss how to implement a growth mindset in your training.

Our training paralleled existing growth mindset training programs (Yeager et al., 2019) by beginning with findings in neuroscience that support the premise of growth mindsets—skills and abilities can be built by all learners through repeated effort and practice (Anderson, Boaler, and Dieckmann 2018). We then introduced mindset theories and beliefs, reviewing work by Carol Dweck, Elizabeth Canning, David Yeager, Kathryn Kroeper, and Mary Murphy, among others. The training included several direct and participatory practice scenarios and reflections. For instance, attendees were asked to identify whether statements conveyed fixed mindsets or growth mindsets—these example statements were edited with each partner to personalize them to their context. Other activities included a guided pair reflection about the causes and consequences of growth and fixed mindsets in areas of life and work; re-framing fixed mindset limiting beliefs to growth mindset statements; and applied practice drafting growth mindset communication (in the spirit of Canning, White, and
Davis, 2024). Attendees of the training have remarked that the re-framing practice parallel strategies advocated for in cognitive behavioral therapy (Beck, 1997).

The training also embedded a direct pre-post assessment (or thin-slice embedded direct assessment as in Hershock et al., 2022), that we discuss next, to support actual practice of the content post-training. The pre-survey was administered in the first five minutes of the training and the post-survey was the penultimate part of the training. With the training concluding with a resource guide shared with all participants that provided specific examples to support implementation, citations, and recommendations for future reading.

3.4 Methodology and Overview of Data Collected

We leverage a sufficiently standardized, but customizable, survey template to collect matched, within-subjects’, pre and post-training data. Introduced in Hershock et al. (2022), this approach is regarded as Thin-Sliced Embedded Direct Assessment (T-SEDA) and was initially postulated as a tool for educational developers, however has great potential for use in training contexts. The key components of a T-SEDA are that they 1) focus on specific measurable skills (thin slices) that are being taught and practiced in the training, and 2) that they are embedded within the training (and thus serve as an opportunity for low stakes practice and new knowledge activation by attendees). T-SEDAs measure immediate impacts of the training: within-subjects changes between the time of starting and ending the training. T-SEDAs do not capture longer-term retention of the training skills, however, proponents argue that we can only anticipate longer-term effects of a training, if the training produces an immediate effect (as measured in the T-SEDA).

For our implementation of a T-SEDA, we use a non-identifying IRB approved embedded survey. The survey begins with informed consent, and then includes pre-training measures for mindset orientation, self-efficacy on partner-specific goals and use of growth mindsets in training, and finally, an authentic, but hypothetical growth mindset communication task. After completing approximately 4 questions, participating attendees reach a mid-survey
pause page that asks they wait to finish the survey until after the training. Then about 70 minutes later, after the training, participants are instructed/asked to finish the survey. The post-training questions nearly exactly parallel the pre-training questions, again measuring mindset orientation, self-efficacy, and asking for attendees to select the most growth mindset-oriented communication.

To measure mindset orientation, we use a modified Growth Mindset Scale (Dweck 1999, 2006). For instance with each partner we modify the general mindset statements to be partner context specific (e.g., “You have a certain amount of skills, and you can’t really do much to improve them.” became, “You have a certain amount of technological skills, and you can’t really do much to improve them.”). Next, we measure self-efficacy, by a numeric rating between 0-100 in response to “I am confident in my ability to...,” complete a specific task following Bandura, 2006. We measure self-efficacy on between 3-6 specific tasks, including at least two that specifically address attendees’ confidence using a growth mindset themselves and supporting their trainees with a growth mindset. The self-efficacy questions are the second area where we further customize our survey to the partner setting, including primary and secondary partner specific goals for their trainers (e.g., in Bidwell’s case, “I am confident in my ability to 1) Support students as they complete job ready technical training., and also 3) Update my course materials to incorporate new and emerging technology.”) Finally, we measure pre-post growth mindset communication, or the ability to identify growth-oriented feedback to a trainee in a hypothetical setting from a single multiple choice response- here alternative responses vary from fixed mindset statements to “toxic” positivity.

As previously mentioned, the survey is provided at the start of the training (within the first minute) and at the end of the training (last few minutes). So, changes in measured mindset, self-efficacy, and communication are immediate effects of the training on those who attend and stay until the end. Using this approach, we thus assume:

• The within-subjects pre-post training differences are due to the training (i.e., the

8In a few instances, we drop observations that ignored the pause page, something we detect by observing the survey completion time measure pre-recorded by Qualtrics- surveys completed in less than 10 minutes did not follow our guidance.
training was fully engaging).

- Longer-term effects of the training are only possible if there is an immediate measurable effect.

- Selection of those who attend the training and in those who join and stay through the end of the training does not determine/drive the pre-post training differences.

Next, we describe the statistical approach.

3.5 Statistical Approach

With within-subjects, pre-training and post-training data we calculate pre-post training differences in mindset by item, average mindset by respondent overall, self-efficacy by item, average self-efficacy by respondent overall, and the proportions who correctly identified the growth mindset communication response. We then conduct Shapiro-Wilk normality test for the differences and use paired t-tests to calculate the p-values and determine if differences are statistically significant (or different from zero). We also ran ANOVAs, looked for differences by training partner using simple linear regression, and finally calculated effect sizes (e.g., Cohen’s $d$, a comparable measure that characterizes the pre-post change in terms of standard deviations).

4 Results

Here we present results associated with our non-identifying T-SEDA survey instrument.

4.1 Mindset Orientation

We measure mindset orientation using an even-forced choice Likert scale ranging from 1 (most fixed mindset) to 6 (most growth mindset). As mentioned above, we ask three-four similar questions in the pre-training and two-three similar questions in the post-training
and present overall averages and pre-post changes in Table 2. Our findings are consistent from item to item, with results being similar throughout. The following is immediately apparent from the aggregated data, among the 65 pre-post matched responses from trainers in Southwestern PA are already oriented in some fashion towards growth mindsets in their workspace, with a mean of 4.8 on a 1 to 6 scale, with a median of 5. That is to say that to some extent respondents endorse and prefer growth mindset beliefs such as the belief that skills and abilities are “malleable,” and can improve with effort. However, there is a large range in average pre-mindset scores and a standard deviation of almost 1.

Table 2: Growth Mindset Orientation Pre-Post Training

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Pre-Post Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.8</td>
<td>5.5</td>
<td>Mean Δ 0.7***</td>
</tr>
<tr>
<td>s.d.</td>
<td>0.9</td>
<td>0.7</td>
<td>95% CI for Mean Δ (0.5, 0.9)</td>
</tr>
<tr>
<td>Median</td>
<td>5</td>
<td>5.67</td>
<td>Median Δ 0.5</td>
</tr>
<tr>
<td>Range</td>
<td>(1.5, 6)</td>
<td>(3.33, 6)</td>
<td>Effect size d 0.88 s.d.</td>
</tr>
<tr>
<td>N</td>
<td>65 matched responses</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** indicates statistical significance, with p-values < 0.001

After the 75-minute intervention, we have a post-training survey where we measure mindset again and find large and statistically significant gains in mindset orientation towards strongly growth mindset-oriented, by .7 points on the 1-6 scale or nearly .9 s.d., a large and statistically significant effect size. Interestingly the standard deviation falls, implying the distribution clusters more tightly around growth mindset beliefs, shifting the lower tail of the distribution upwards and reducing the overall range of beliefs. As shown in the appendix, we do not find statistically significant differences in the gains in growth mindsets between groups.

4.2 Self-Efficacy or Confidence

As previously mentioned, we are interested in self-efficacy measurements for several key reasons: self-efficacy highly correlates with growth mindset, motivation, performance, and worker engagement. Additionally, we hypothesize that the growth mindset training has
the potential to produce self-efficacy improvements, particularly among respondents’ use of
growth mindset behaviors in their training program teaching, mentorship, and leadership.
Further, our growth mindset training may also have a positive effect on self-efficacy during
core working tasks, as trainees see how growth mindset orientation is relevant to their core
work objectives, which we will discuss next.

4.2.1 Self-Efficacy Incorporating Growth Mindsets

Responding to prompts such as “I am confident in my ability to...,” 1) Incorporate a growth
mindset in your teaching/training, 2) Incorporate growth mindset activities yourself/in your
broader life, or 3) Help students/trainees adopt or sustain a growth mindset, we collect self-
efficacy or confidence measurements. Measured on a 0-100 scale, changes pre-post training
can be interpreted in percentage points. The results are presented in Table 3.

<table>
<thead>
<tr>
<th>Table 3: Self-Efficacy Using Growth Mindsets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>s.d.</td>
</tr>
<tr>
<td>Median</td>
</tr>
<tr>
<td>Range</td>
</tr>
<tr>
<td>N</td>
</tr>
</tbody>
</table>

* *** indicates statistical significance, with p-values < 0.001

Prior to the growth mindset training, among those who joined the training, have a
wide range of self-confidence ratings using growth mindsets: between 10% confident in their
abilities to 100%, or fully, confident. The mean and median are similar around 74%, however
there is a large standard deviation (17 points). Post-training, after 75 minutes of discussing
and applying what we learned about growth mindset communication, self-efficacy evaluations
improved by a highly statistically significant 13.8 percentage points, an effect size of $d$ of
0.84 standard deviations. Post-training, the left tail of the distribution shifts upward, now
confidence ratings range between 58 and 100, with a mean of nearly 88% and median of 90%
and compressed standard deviation. As shown in the appendix, we do not find statistically
significant differences in the gains in confidence using growth mindsets between groups.

### 4.2.2 Self-Efficacy on Partner Specific Goals

As self-efficacy measures confidence on a specific task, one way we customize and co-create our survey instrument with our community partners is by facilitating the collection of self-efficacy measurements on our partners’ specific goals. For instance, one partner, a community robotics training program for youth had the goal for their trainers to, “Support students as they build and program their robots,” and so that goal was included and measured in the survey. Many partners found reviewing data collected on their goals to be useful outside of this collaboration. However, for some partner’s goals, the growth mindset training may be highly relevant. For instance, another partner had the goal of “Provide honest, constructive, and strength-based feedback to my mentee(s),” a goal that we perceived to be both complementary and relevant to our general growth mindset adoption goals.

Table 4 describes the pre-training, post-training, and change pre-post aggregating among all partner goals. As we anticipated there was not as wide of a range in self-efficacy evaluations in the pre-training partner specific goals, as the trainers participating already worked to accomplish these goals as part of their usual job description- the mean and median pre-training was around 80%. Still, post-training the average and median confidence did increase by almost 9 percentage points (a statistically significant change) with an effect size of about 0.6 standard deviation. We postulate that this increase is driven by trainers finding the growth mindset training material relevant to the core responsibilities associated with their

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Pre-Post Difference</th>
</tr>
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<tr>
<td>Mean</td>
<td>78.6</td>
<td>87.1</td>
<td>Mean ∆ 8.4***pp</td>
</tr>
<tr>
<td>s.d.</td>
<td>15.9</td>
<td>10.4</td>
<td>95% CI for Mean ∆  (5pp, 12pp)</td>
</tr>
<tr>
<td>Median</td>
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<td>90</td>
<td>Median ∆ 5pp</td>
</tr>
<tr>
<td>Range</td>
<td>(35, 100)</td>
<td>(60, 100)</td>
<td>Effect size d 0.59 s.d.</td>
</tr>
<tr>
<td>N</td>
<td>65 matched responses</td>
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</tr>
</tbody>
</table>
work. In the appendix, we examine heterogeneity by partner and acknowledge that while some results by partner subgroup are statistically insignificant, small sample size (and thus minimum detectable effect sizes) contributes to imprecision in the estimates.

4.3 Authentic, but Hypothetical Task: Growth Mindset-Oriented Communication

A key goal of the growth mindset training we developed and delivered was to support job trainers utilizing growth mindsets in their training programs— a growth mindset is most often conveyed to a trainee via direct communication between the trainer and the trainee, and thus we seek to measure how trainers might respond to a trainee who is facing difficulty pre- and post-training. To do this, we ask respondents to “select the most growth-oriented response,” among four options in response to a hypothetical scenario, during both pre- and post-training. We support trainers understanding on the post-training task, by speaking about the pre-training task during the training session (i.e., trainers discuss the most growth-oriented response to the first scenario during the training). They then are asked a similar scenario post-training, with four additional statement options ranging from fixed to growth mindsets.

Table 5: Pre- and Post-Training Growth Mindset Communication Task

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Pre-Post Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.88</td>
<td>0.97</td>
<td>Mean Δ</td>
</tr>
<tr>
<td>s.d.</td>
<td>0.33</td>
<td>0.18</td>
<td>0.08$^t$</td>
</tr>
<tr>
<td>Effect size d</td>
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<td></td>
<td>0.3 s.d.</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>64 matched responses</td>
<td></td>
</tr>
</tbody>
</table>

The pre-training and post-training scores are presented in Table 5 seen above. While post-training growth mindset communication response selection improved by eight percentage points, this result was only marginally statistically significant (the p-value of 0.058 implies the 95% confidence interval includes zero).
4.4 Feedback from Participants

In all the training we provided, we asked a few questions that solicited direct feedback from attendees. These questions asked folks to “Please indicate your level of agreement the following statement: The blank was/were a valuable experience,” with three subcategories: 1) the training session as a whole, 2) the pre and post survey activities, and 3) the in-training interactive activities. Here we visualize the proportion of respondents who respond according to an odd numbered Likert scale with five options ranging from strongly agree to strongly disagree.

As seen in Figure 2, over 70% of responses agree or strongly agree that all three subcategories were a valuable experience. We noticed some resistance to the survey in particular, and rationalize this as potential resistance to a feeling of being assessed, even considering a non-identifying survey instrument. We were delighted to see folks enjoyed the group activities.

![Figure 2: Proportions of Responses to Feedback on the Training Questions](image)
4.5 Anecdotal, Descriptive, and Qualitative Findings

There were two other sources of anecdotal, descriptive, or qualitative findings. First, the survey included a feedback section with an open ended question asking, “We welcome your feedback on the survey and training- you can provide it here, if you would like.” Additionally, when reviewing results with our training partners, we reserved time for the partners to share about their perceptions of how the training went. In the appendix we list all comments we received and generally found the comments were positive, and we particularly appreciated suggestions for ways to improve the training. For example, in one response we received the recommendation to reduce the number of words on each slide as well as a suggestion on how we might re-order information to emphasize key points (“I appreciate the note that growth mindset is not just about generic encouragement and optimism. I think that should come earlier and more prominently...”).

For the responses with actionable feedback, we followed up with the partners about any outstanding questions. Additionally, when prompting the partners to reflect in our post-training results meetings, we asked them to share if they heard about or had seen examples of the training topics in the weeks or months since we led the training. In all instances, our community partners emphasized that there were a number of trainers who attended who continue to speak and use growth mindsets in their teaching, training, and mentorship. Partners specifically picked out which parts of the training resonated the most- with the “effort, support, and strategies,” framing for how growth is possible, and the actionable guidance shared with the resource links being identified as most helpful. Additionally, two training partners independently decided to print growth mindset messaging on posters to hang in their training centers for their students/trainees to see, as a way to signify, and create a growth-oriented culture.
5 Conclusions and Discussion

In this paper, we discuss a short, collaborative and participatory Growth Mindset Training programming that we developed in consultation with existing literature. We then assess its immediate impacts with a thin-slice embedded direct assessment. We find the training is associated with improvements in growth mindset orientation, self-efficacy on both growth mindset and primary training goals, and growth mindset communication using matched within-subjects data collected from multiple training settings. Our effect sizes for mindset and self-efficacy improvements are large (nearly 1 s.d.) and highly statistically significant. Additionally, we find post-training the distribution of mindset is shifted right/up and tightened (lower spread).

This work contributes to a large literature examining the role of mindsets. Specifically, we study job training programs in Southwestern PA focused on the use of emerging technologies at work. Throughout the project, we practiced building community engagement and training capacity through applied research to practice. By creating and sharing open access resource guides\(^9\) for the partners with implementation examples, suggestions for continued engagement, and citations, we hope to enable broader implementation and build capacity at existing community groups. We also encouraged partners to continue and/or revisit the training in the future and shared our slides to enable that, as the principles of Community-Based Participatory Research recommend supporting replication amongst community partners. Finally, we learn from and value our community partners and highly recommend this research approach to other researchers. The community groups we worked with taught us about their work, informed our research questions, the training content/context of examples, and the hypotheses we examined in our statistical analysis.

Our approach made several assumptions. First we argue the immediate effects measured are due to the training among those trained. We feel this is a reasonable assumption particularly as our training was participatory and required near full engagement, even when conducted on Zoom (however, we do not find statistically significant differences between

\(^9\)See Bidwell’s Guide as an example.
training settings in person vs. Zoom). Secondly, we assume there is no selection among those who stay through the end of the training. We tested this by comparing the pre-training measures of the outcomes between the group of those who stay until the end and complete the survey versus those who only complete the pre-survey and do not find statistically significant differences. With some large partners, we also attempted to measure baseline (pre-training) responses to the survey among those who were unable to attend the training due to scheduling issues—we do not find statistically significant differences but face small sample constraints. As a result of the small sample in our data, we cannot rule out that our null estimates for selection are a result of insufficient statistical power (or the ability to detect a small selection effect, if there is one). Lastly, our results are immediate measures and because we find large and robust immediate improvements, we anticipate there will be longer-term positive effects. However, these effects could be larger (if attendees continue to learn more about, experiment, and implement growth mindsets in their training program) or smaller (if benefits/gains erode over time) than our original observations.

**Future Research**

In future research, we hope to explore/examine whether this training influenced student/trainee outcomes, specifically their experience in the training, retention/completion, and their own mindset, self-efficacy, and performance. We and other researchers might also consider studying the longitudinal or longer term impacts of growth mindset training—do the immediate findings we present here persist and if so, for whom and under what conditions? Finally, does a growth mindset training inspire organizational cultural change or greater inclusion?

**Suggestions for Training Programs**

Given the positive results for trainers, we encourage more training programs to incorporate growth mindsets in their trainer development and training courses. While growth mindsets have been leveraged in K12 and higher education, we find that they are relevant to job
training as well. Managers and workers alike can leverage a growth mindset in their own and their teams’ development and the strategies discussed may influence their retention and workplace success.

As growth mindsets are not only internal, but also conveyed by the cultural norms at an organization, we feel that growth mindset training is relevant not only to the trainers, but also for the leaders of these organizations. We would also recommend that training programs be attentive to the effects of growth mindset interventions over time (multi-year longitudinal studies), as questions remain in practice and in the literature about the long-term effects of a growth mindset intervention at the organizational level.

Finally, our project used a pre-post embedded direct assessment within our growth mindset training session. This instrument does not just count those trained, we measure whether or not the training led to meaningful changes in mindset orientation, self-efficacy or confidence as trainers and use of growth mindset, and growth mindset communication for student support. We encourage all training programs to collect and analyze pre-post data as a mechanism to examine and quantify the changes and learning that occurs in their programs. Training programs without research capacity on their full time staff may find collaborating with community-engaged academics to be mutually beneficial.

References


Online Appendices

Data Availability

Non-identifiable data and the code to reproduce the results within this paper are publicly available at OpenICPSR- openicpsr-205261.

Author and Non-Author Contributions

Ashley E. Orr is the principal investigator, she developed the study concept; acquired funding to support the projects' implementation; collected and reviewed initial literature; drafted and piloted the initial growth mindset training; drafted, submitted, and revised the human subjects research IRB protocol; drafted and revised the pre-post survey instrument and implemented it in Qualtrics; recruited, communicated, and liaised with community partners using a standardized approach; cleaned the survey data; completed the primary analysis and robustness checks; screened, hired, and trained the two research assistants; trained, mentored, and supported the primary research assistant from October 2023-June 2024, leading at least bi-weekly research meetings; submitted all quarterly grant reports; and, applied to present at the LERA conference. Ashley and Jacob worked together to revise and co-create with community partners the training slides and final survey drafts for each partner, depending on availability. Ashley and Jacob outlined the conference slides and paper collectively. Ashley led the paper drafting, Jacob was the primary writer of the literature review where he synthesized literature across several disciplines. Extremely valuable edits, questions, and revisions of the paper were from Jacob, who also ensured all citations were present. Ashley and Jacob co-led the result presentation to community partners, if they both were available for those meetings, otherwise, Ashley presented their findings on their behalf. Both Ashley and Jacob attended and co-presented at the LERA conference. Jacob recruited additional funding from the Heinz College to offset his travel costs. We thank Busola Adeshina for her research assistance early in this project (between Oct. 2023 - Jan. 2024), Busola joined us for meetings with two of the community partners and reviewed a few of the papers we cite.
A: Example Training photo, with participant consent

Here’s an example of the training implementation:

Figure 3: A photo from one training in April 2024 in Allegheny County, PA
B: All Comments Received in the Feedback

- “Be sure to appropriately to me your presentation & activities. Too many words per slide. Enjoyed pair-share.”
- “I appreciate the note that growth mindset is not just about generic encouragement and optimism. I think that should come earlier and more prominently. I often hear growth mindset as a bland positivity, not a concrete way to support and strategize.”
- “I hope this resonates with coworkers that don’t exhibit a ton of growth mindset”
- “I loved the mix of sharing information and having us process in break out rooms. I know breakout rooms scare people away but I found it useful. I would like to have opportunities to discuss this in the future”
- “I’m enjoying this experience thus far and look forward to implementing the things that I have learned”
- “It was a really great training and very informative.”
- “Maybe a part 2 to do a deeper application of the principles covered.”
- “Need more clarity on role of mentorship— are we supposed to be providing academic support? Obviously we want our students to succeed, but mentorship is more than just additional academic check-ins!”
- “Thank you so much. The links are so helpful as well”
- “The interactive conversations were relevant and helpful. Thank you for a GREAT topic!”
- “This was a great and informative training! I especially liked the conversations that I had with others in the breakout rooms / reflection questions.”
- “This was extremely helpful! I appreciate the information and plan to practice suggested practices, immediately!”
- “This was very helpful to remind me of my own barriers, and places for improvement in my overall delivery of information and communication with staff and students!”
C: Testing Critical Assumptions

A primary concern with the assessment of a non-randomized training interventions is selection bias, whereby we would anticipate that pre-post training changes in outcomes are not generalizable or externally valid. To address this we consider whether those who complete the training and activities are different than those who have to leave or were unable to attend the training. We do this in two steps:

1. Compare the pre-training data for one partner who had high attrition during the training. Compare those who started the survey/training and left (N=23) and those who finish it (N=9 of 32 total)?

2. For another partner, collect pre-training data from among those who were unable to attend the training due to scheduling availability (N=3 of 19 total) and compare to those who attended.

Table 6: Pre-Training Outcomes Regression Results

| Pre-Training Mindset Average | Estimate | Std. Error | t value | Pr(>|t|) |
|-----------------------------|----------|------------|---------|----------|
| Intercept                   | 4.79     | 0.19       | 25.79   | 0.00     |
| I(Have Complete Post Data)  | 0.12     | 0.35       | 0.35    | 0.73     |

| Pre-Training Self-Efficacy on Partner Goals | Estimate | Std. Error | t value | Pr(>|t|) |
|--------------------------------------------|----------|------------|---------|----------|
| Intercept                                  | 82.65    | 2.76       | 29.94   | 0.00     |
| I(Have Complete Post Data)                 | -5.99    | 5.21       | -1.15   | 0.26     |

| Pre-Training Self-Efficacy on Using Growth Mindsets | Estimate | Std. Error | t value | Pr(>|t|) |
|----------------------------------------------------|----------|------------|---------|----------|
| Intercept                                          | 76.46    | 3.85       | 19.88   | 0.00     |
| I(Have Complete Post Data)                         | -5.72    | 7.25       | -0.79   | 0.44     |

| Pre-Training Growth Mindset Communication Task | Estimate | Std. Error | t value | Pr(>|t|) |
|------------------------------------------------|----------|------------|---------|----------|
| Intercept                                      | 0.96     | 0.04       | 25.69   | 0.00     |
| I(Have Complete Post Data)                     | 0.04     | 0.07       | 0.62    | 0.54     |

N=32

Simple linear regression results are presented in Table 6, and as seen the indicator for
completing the training is statistically insignificant for all four outcomes considered. Similarly, simple linear regression results for the partner we collected pre-training data for among those who were unable to join due to scheduling difficulties is presented in Table 7. The indicator for not attending is also statistically insignificant. Taken together this provides limited suggestive evidence that the groups are not different pre-training.

Table 7: Pre-Training Outcomes Regression Results: Did not attend

| Pre-Training Mindset Average | Estimate | Std. Error | t value | Pr(>|t|) |
|-----------------------------|----------|------------|---------|---------|
| Intercept                   | 5.05     | 0.16       | 31.87   | 0.00    |
| I(Did not attend)           | 0.62     | 0.40       | 1.56    | 0.14    |

| Pre-Training Self-Efficacy on Partner Goals | Estimate | Std. Error | t value | Pr(>|t|) |
|---------------------------------------------|----------|------------|---------|---------|
| Intercept                                   | 78.62    | 3.73       | 21.06   | 0.00    |
| I(Did not attend)                           | 11.38    | 9.39       | 1.21    | 0.24    |

| Pre-Training Self-Efficacy on Using Growth Mindsets | Estimate | Std. Error | t value | Pr(>|t|) |
|----------------------------------------------------|----------|------------|---------|---------|
| Intercept                                           | 77.31    | 2.92       | 26.46   | 0.00    |
| I(Did not attend)                                   | 12.13    | 7.35       | 1.65    | 0.12    |

| Pre-Training Growth Mindset Communication Task | Estimate | Std. Error | t value | Pr(>|t|) |
|------------------------------------------------|----------|------------|---------|---------|
| Intercept                                       | 0.94     | 0.06       | 15.97   | 0.00    |
| I(Did not attend)                               | 0.06     | 0.15       | 0.42    | 0.68    |

N=19
D: Heterogeneity in Pre-Post Differences by Group

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Mindset Gain</th>
<th>SE GM</th>
<th>SE Partner</th>
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N=65, Coefficient Estimate with Std. Error in parentheses

*** p-value < 0.001, ** p-value < 0.01, * p-value < 0.05, t p-value < .1